X-ray Astronomy at SLAC[1]

P. M. Saz Parkinson[2]

Stanford Linear Accelerator Center, Stanford University, Stanford, CA 94309

Abstract

The USA (*Unconventional Stellar Aspect*) experiment was launched in February of 1999 and operated for approximately 18 months. Group K at SLAC (Stanford Linear Accelerator Center) participated in this experiment along with the Naval Research Laboratory (NRL). I discuss the USA experiment and the data accumulated, along with some of the results obtained from the observations of such objects as the extragalactic BL Lac object 1ES1959+65, the Black Hole Candidate (BHC) XTE J1118+480, and the eccentric X-ray binary system Circinus X-1.

The USA experiment

USA is an X-ray timing experiment built jointly by the Naval Research Laboratory and the Stanford Linear Accelerator Center. USA was launched on 1999 February 23 on the Advanced Research and Global Observation Satellite (*A*RGOS), into a nearly circular 830 km Sun-synchronous orbit at 98.8° inclination.

USA is sensitive in the energy range 1–15 keV with an effective area of about 1000 cm^2 at 3 keV and a field of view which is approximately 1.2° FWHM circular. The Crab Nebula gives about 3600 $cts\,s^{-1}$ at the center of the field of view. Most observations were taken in an event mode, with 32 μs time resolution and 16 pulse height channels. For more details on the USA instrument see [Ray et al.(1999)].

USA Observations

Table 1 shows the total amount of USA data accumulated. The data is grouped by object class. For each class I list the top three sources observed by USA.

1ES1959+65

USA observed this BL Lac object, at the time a potential TeV emitter, and detected variability on the timescale of a few days with a three-fold flux increase, consistent with what has been observed in the optical band at other times. A correlation was observed between the X-ray flux and the spectrum, with the spectrum hardening as the source becomes brighter [Giebels et al.(2002)].

[1]Work at SLAC was supported by Department of Energy contract DE-AC 03-76-SFO0515. Basic research in X-ray astronomy at the Naval Research Laboratory is supported by ONR/NRL. This work was also supported by the NASA Applied Information Systems Research Program

[2]for the USA collaboration. e-mail: pablos@SLAC.stanford.edu

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
DEC 2002		**00-00-2002 to 00-00-2002**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
X-ray Astronomy at SLAC	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Stanford University,Stanford Linear Accelerator Center,Stanford,CA,94309**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**		**2**	

Table 1: Summary of USA observations

Class	Exposure (ks) [a]	Examples [b]
AGN	655	Mkn 421 (300), 3C273 (120), 1ES1959+650 (60)
BHC	1835	Cyg X-1 (700), XTE J1118 (320), GRS 1915 (290)
AXP	765	X0142+614 (250), E2259+586 (205), 1E1048.1 (120)
PSR	1255	Crab (600), PSR 1509-58 (205), PSR B0540-69 (90)
NS LMXB	2680	Cyg X-2 (355), Cir X-1 (235), EXO 0748 (230)
XPSR	1300	SMC X-1 (315), Cen X-3 (210), LMC X-4 (170)

[a]approximate amount of raw data accumulated
[b]Top three sources with the most amount of data, shown in ks in parentheses

XTE J1118+480

The black hole transient XTEJ1118+480 was discovered by RXTE during the second of two outbursts that it underwent in 2000 [Remillard et al.(2000)]. USA observed the source from 10 April to 11 June of 2000 and tracked the evolution of a low frequency ($\sim$0.1 Hz) QPO, showing that the QPO frequency is not correlated with the source flux [Wood et al.(2000)].

Circinus X-1

Circinus X-1 is currently classified as a NS due to the detection of Type I X-ray bursts by EXOSAT in the 1980s. We studied the timing and spectral evolution of Cir X-1 around its 16.6 day orbit. We modeled its energy spectrum with two components, one representing the disk and one representing a Comptonizing region. We studied the numerous QPO present in Cir X-1 and determined that their origin probably lies in the Comptonizing region, rather than the disk. We compared the power spectrum of Cir X-1 to that of the BHC Cyg X-1 and found that if scaled by 3.8, the two breaks in both spectra coincide. If these breaks are inversely proportional to the mass, this would imply a mass for Cir X-1 in excess of the canonical mass for a neutron star [Saz Parkinson (2003)].

References

[Giebels et al.(2002)] Giebels, B. et al. 2002, ApJ, 571, 763

[Ray et al.(1999)] Ray, P. S. et al. 1999, Proceedings of X-ray Astronomy 1999, Bologna, Italy, AIP Conference Proceedings, 599, 336 (2001), astro-ph, 9911236

[Remillard et al.(2000)] Remillard, R., Morgan, E., Smith, D., & Smith, E. 2000, IAU CIRC, 7389, 2

[Saz Parkinson (2003)] Saz Parkinson, P. M. 2003, PhD Thesis, Stanford University

[Wood et al.(2000)] Wood, K. S. et al. 2000, ApJL, 544, L45